

DEVELOPMENT OF KALAMANSI NIP WITH GINGER EXTRACT

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ABSTRACT

The study was geared towards the production of kalamansi nip enhanced with ginger extract. It was conducted to determine the acceptability of kalamansi nip with ginger extract with its concentration, acceptability of nip and juice among different market segments, available nutrients, shelf-life, and profitability of production. Experiments were carried out in a Completely Randomized Design and subjected to sensory evaluation. The nip was prepared with different ginger ratios: T1 (control), T2 (5%), T3 (10%); T4 (15%). Results showed that 5% ginger extract concentration had a higher acceptability. Using a 5% concentration of ginger, the researchers tested the nip and juice's acceptability through sensory evaluation among different market segments. The evaluators liked both products. Laboratory analysis revealed that the kalamansi nip with ginger extract was found to contain 327 kcal per 100g, 71.35% carbohydrates, 4.55% crude fat, 4.12% saturated fat, 0.19% crude protein, 43.68 µg/g sodium, 508 µg/g potassium, and 101µg/g calcium. The kalamansi nip and juice lasted at room temperature for 51 and 3 days, respectively. In addition, kalamansi nip production had a promising return of 15 to 35%, depending on the amount of ginger extract.

Keywords: Product development, acceptability, nutrient analysis, shelf-life, profitability

INTRODUCTION

Health and well-being are a prevalent and important topic of interest today, especially among children and adolescents. Studies have shown that there is an increasing epidemic of childhood obesity in industrialized and urbanized communities (Ebbeling et al., 2002; Lobstein et al., 2004; Wang & Lobstein, 2006) and in developing countries (Wang & Lobstein, 2006; Gollosso-Gubat et al., 2015). The Philippines is not an exception, as the increase in overweight and obesity levels in children and adolescents continued from 2003 to 2011 (FNRI-DOST, 2010; FNRI-DOST, 2012).

The Department of Education (DepEd) Order No. 8, s. 2007 specifies that “School canteens shall serve as a place for the creation of appropriate pupil/student eating habits.” In particular, the guidelines stipulate that drinks sold in public elementary and secondary schools shall include milk, shakes, and juices prepared from fruits and vegetables during the season, while the sale of carbonated juices, sugar-based synthetic, or artificially flavored juices shall be prohibited.

However, school-based food provision and sales account for a significant proportion of children’s food intake. Even in schools, children and adolescents are constantly targeted by the food industry through aggressive marketing campaigns, with evidence showing that food marketing to people under the age of 18 is controlled by unhealthy food and drink (Reeve et al., 2018). Apart from children, there are people nowadays who are obsessively conscious about their health. Kalamansi has a characteristic that can aid in weight loss, and ginger is rich in medicinal properties that help the body detoxify and provide a general boost to the immune system.

OBJECTIVE OF THE STUDY

This study lays the groundwork for the development of a new, refreshing, and healthy juice drink made from kalamansi, enhanced with ginger extract. The value-added approach is expected to improve the quality of natural kalamansi nips compared to other processed and synthetic kalamansi concentrates and commercially available juices.

REVIEW OF LITERATURE

Food and Beverage Consumption and Health Issues

Survey data from different countries indicated a growing epidemic of childhood obesity in developed and urbanized populations (Ebbeling et al., 2002; Lobstein et al., 2004; Wang & Lobstein, 2006) and in developing countries (Wang & Lobstein, 2006; Gupta et al., 2012). The Philippines faces

an extreme double burden of malnutrition (ASEAN, WHO, UNICEF, 2016). Stunting affects over 30% of children under the age of 5 (Hwalla et al., 2014), and diet-related NCDs are steadily increasing. NCDs accounted for 67% of total deaths in 2014, up from 61% in 2010 (World Health Organization, 2014). Undernutrition coexists, there is a continued increase in the prevalence rates of overweight and obesity in children and adolescents from 2003 to 2011 (FNRI-DOST 2010; FNRI-DOST 2012).

Among the important dietary changes in children and adolescents are the increased consumption of sugar-sweetened beverages and decreased milk intake (Blum et al., 2008; Striegel-Moore et al., 2006; Garrigues, 2008), which were associated with BMI (Blum et al., 2005; Striegel-Moore, 2006; Collison et al., 2010), waist circumference, dietary choices (Collison et al., 2010) and greater risk for overweight and obesity over time (Ludwig et al., 2001; Berkey et al., 2004).

The Department of Education (DepEd) Order No. 8, Series of 2007, states that “School canteens shall serve as a venue for developing desirable eating habits of pupils/students.” In particular, the guidelines stipulate that beverages sold in public elementary and secondary schools shall include milk, shakes, and juices prepared from fruits and vegetables in season. The sale of carbonated, sugar-based synthetics or artificially flavored juices is prohibited. Likewise, the Department of Education 2017 issued DO 13 series of 2017 provides the policy and guidelines on healthy food and beverage choices in schools and offices. The Policy and Guidelines aim to make available healthier food and beverage choices among the learners and DepEd personnel and their stakeholders; to introduce locally available foods and drinks in accordance with geographical, cultural, and religious orientations; to provide guidance in evaluating and categorizing foods and drinks; and to provide guidance in the selling and marketing of foods and beverages in schools and DepEd offices, including the purchasing of foods for school feeding.

Product Development and Innovation

Product development is a series of steps that include the conceptualization, design, development, and marketing of newly created or newly rebranded goods or services. It is intended to cultivate, maintain, and/or increase market share by satisfying consumer demand (Baker, 2004). Successful product innovation can lead not only to products that satisfy the existing needs of customers but also to market-expanding breakthrough products that meet new customer needs (Innocence, 2015).

The Health Benefits of Kalamansi

Kalamansi (*Citrus macrocarpa*) is a fruit grown throughout Southeast Asia and is very popular in the Philippines as the “Golden Lime.” It is said to be a good source of vitamin C. Moreover, its fruit has been processed into syrups, juices, concentrates, and purees. Its juice is used as a flavoring or an

additive in various food preparations to enhance iron absorption. It can be used as a good ingredient in making various juices and beverages (Helmiyetti, 2013).

Kalamansi is rich in phosphorus, calcium, iron, and Vitamin C, also known as ascorbic acid. It is the most popular and most commonly used citrus fruit in the country. Its juice is nutritious and traditionally made into a fruit drink that helps prevent respiratory diseases. It also helps strengthen bones and stimulates growth in children. Kalamansi has antibacterial properties, making it an effective mouthwash as it eliminates morning breath. In addition, calamansi is cheaper than many over-the-counter health and beauty products yet contains similar benefits, all-natural.

Ginger and its Health Benefits

Ginger (*Zingiber officinale*) is a flowering plant with a rhizome. The ginger root, or simply ginger, is widely used as a spice or folk medicine. It is a herbaceous perennial that grows annual stems about a meter tall, bearing narrow green leaves and yellow flowers. Ginger belongs to the family Zingiberaceae, which also includes turmeric (*Curcuma longa*), cardamom (*Elettaria cardamomum*), and galangal. Ginger is an excellent companion, warming the body, improving circulation, and activating the body's defenses. Ginger has a very useful function during colds, flu, virus infections, coughs, chronic bronchial problems, and low-grade infections of all kinds. Compounds from ginger include those that inhibit salmonella typhi, vibrio cholerae, and *Trichophyton violaceum*.

Macro and Micro Nutrients and their Importance

Calories are a measure of the energy content in food or drink. Calories and kilocalories are commonly used as shorthand for kilocalories, which are denoted as kcal on food packets. Kilojoules (kJ) are the equivalent of kilocalories within the International System of Units, and both kJ and kcal are used on nutrition labels – 4.2 kJ is equivalent to approximately 1 kcal (Ng et al., 2012). Lupton et al. (2002) noted that children and adults should consume 45 to 65 percent of their daily calorie intake as carbohydrates, with at least 130 grams of carbs per day. Lowering carb intake and increasing protein intake can help reduce calorie intake for weight loss; it is recommended that 50 percent of calories be consumed from carbs for successful weight loss. Athletes require more carbohydrates to replace muscle glycogen lost during physical training; some athletes need up to 70 percent of their calorie intake from carbohydrates.

Carbohydrates

The calamansi nip also contains 71.35% carbohydrates. Carbohydrates are the body's main source of energy and should make up the largest percentage of the daily calorie intake (Coleman, 2015). Traces of crude fat (4.55%), saturated fat (4.12%), and crude protein (0.19%) were also determined in the laboratory

analysis.

Crude fat

Crude fat content is determined by extracting the fat from the sample using a solvent and then determining the weight of the fat recovered. As lipids/fats are relatively non-polar molecules, they can be extracted from a sample using relatively non-polar solvents. With a non-polar solvent, only non-polar molecules in the sample dissolve, while polar ones do not. However, problems arise in cases where lipids are bound in animal or plant cell membranes. Animal and plant cell membranes are composed of molecules that have both polar and non-polar regions, such as triglycerides (molecules with polar glyceride heads and non-polar fatty acid tails) and phospholipids (similar to triglycerides, but with a phosphate group replacing the fatty acid tail). These molecules tend to group with their polar heads sticking outwards and non-polar tails inwards, making it difficult for non-polar solvents to interact with the non-polar tails and extract (Thiex et al., 2003).

Saturated fat

Saturated fats are less healthy than polyunsaturated and monounsaturated fats. Rich sources include palm oil, butter, and animal fats such as those found in red meat, poultry, full-fat dairy products, chocolate, and cheese.

Crude Protein

Crude Protein is a structural molecule made up of amino acids, many of which the body cannot produce on its own. Animal foods are usually high in protein, with all the essential amino acids we need (Nadolsky, 2014). Moreover, the calamansi nip with ginger extract also contains 43.68µg/g sodium. According to Martinac et al. (2007), sodium is one of several minerals that serve as electrolytes, whose primary function is to regulate fluid in cells. The upper limit for sodium set by the Institute of Medicine is equivalent to 1 teaspoon daily for healthy adults under 50 years of age.

The presence of potassium (508µg/g) was also noted in the Kalamansi nip. According to Kern (2008), fewer than two percent of American adults consume the recommended daily amount of potassium, currently set at 4,700 milligrams for most people. Potassium plays a crucial role in maintaining bone strength, preventing kidney stone formation, and reducing the risk of stroke, as well as being an essential electrolyte. It is part of the electrochemical balance that keeps the nervous system functioning properly. Therefore, getting enough through diet or supplements is a significant goal for most people.

The calcium content in the calamansi nip is 101.00 µg/g. This essential mineral is found in some foods, added to others, available as a dietary supplement, and present in certain medicines, such as antacids. Calcium is required for vascular contraction and vasodilation, muscle function, nerve transmission, intracellular signaling, and hormonal secretion. Although less

than 1% of total body calcium is needed to support these critical metabolic functions, calcium plays a crucial role. Serum calcium is tightly regulated and does not fluctuate with changes in dietary intake. The body uses bone tissue as a reservoir for and source of calcium to maintain constant concentrations of calcium in blood, muscle, and intercellular fluids (Karoehl et al., 2010).

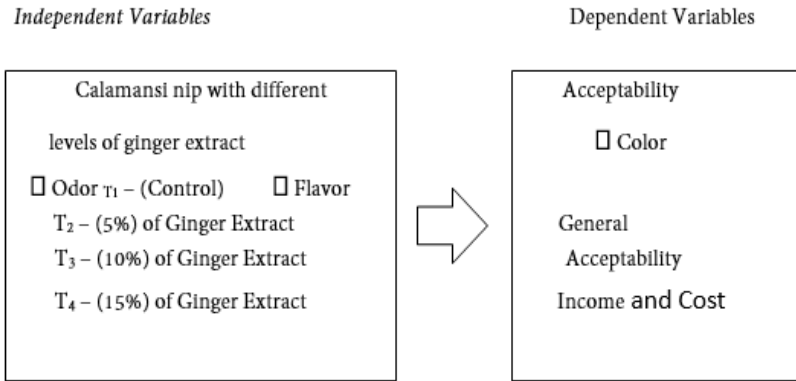
There is 3.73 $\mu\text{g/g}$ of iron available in the calamansi nip. Iron is a mineral vital to the proper function of hemoglobin, a protein needed to transport oxygen in the blood. Iron also plays a role in various other important bodily processes. Iron helps to preserve many vital functions in the body, including general energy and focus, gastrointestinal processes, the immune system, and the regulation of body temperature. The benefits of iron often go unnoticed until a person is not getting enough. Iron deficiency anemia can cause fatigue, heart palpitations, pale skin, and breathlessness (Ware, 2008).

Moreover, 46.35 $\mu\text{g/g}$ of magnesium was found in the kalamansi nip. According to Erdman et al. (2012), magnesium, an abundant mineral in the body, is naturally present in many foods, added to other food products, available as a dietary supplement, and present in some medicines (such as antacids and laxatives). Magnesium is a cofactor in more than 300 enzyme systems that regulate diverse biochemical reactions in the body, including protein synthesis, muscle and nerve function, blood glucose control, and blood pressure regulation. Magnesium is required for energy production, oxidative phosphorylation, and glycolysis. It contributes to the structural development of bone and is required for the synthesis of DNA, RNA, and the antioxidant glutathione. Magnesium also plays a role in the active transport of calcium and potassium ions across cell membranes. This process is important to nerve impulse conduction, muscle contraction, and normal heart rhythm. Moreover, 5.64 $\mu\text{g/g}$ of phosphorus is also found in the kalamansi nip. Wellman (2004) mentioned that phosphorus is the second most plentiful mineral in the body. The first is calcium. The body needs phosphorus for many functions, such as filtering waste and repairing tissue and cells.

CONCEPTUAL FRAMEWORK

Study 1: *Acceptability of Kalamansi Nip with Ginger extract at different levels*

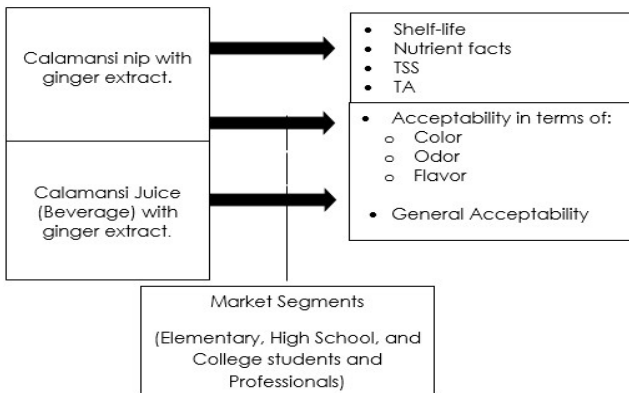
Figure 1. Schematic Diagram showing the relationship between the Independent and Dependent variables of the study: Acceptability of Kalamansi Nip with Ginger extract at different levels



The above diagram illustrates that the acceptability of kalamansi juice from kalamansi nip, in terms of color, odor, flavor, and general acceptability, may vary depending on the different levels of ginger extract added to the kalamansi nip mixture. The income and cost ratio is also expected to differ among the various treatments.

Study 2: Nutrient Analysis, Shelf-Life, and Acceptability of Kalamansi Nip with Ginger Extract Among Different Market Segments (Elementary pupils, High School and College Students, and Professionals).

Figure 2. Schematic Diagram showing the relationship between the independent and Dependent variables of the study



The figure shows the variables of the study. The dependent variables included sensory evaluation of acceptability, nutrient facts, and shelf life of calamansi nip with ginger. The acceptability of the calamansi nip and juice with ginger extract is expected to vary among different market segments, which serve as moderating variables, thereby identifying the right segment to target for marketing the product.

METHOD

Research Locale

The processing of kalamansi nip was conducted at Southern Philippines Agri-Business and Marine Aquatic School of Technology (SPAMAST) Buhangin Campus, located at Barangay Buhangin, Malita, Davao Occidental. Sensory evaluation was performed at the respective locations of the respondents, as follows: Buhangin Elementary School for elementary pupils, Tubalan National High School for high school respondents, SPAMAST for tertiary respondents, and the DPWH-Buhangin and SPAMAST for professional respondents. The respondents were randomly selected to evaluate the acceptability of kalamansi nip with ginger extract in terms of flavor, color, odor, and overall acceptability.

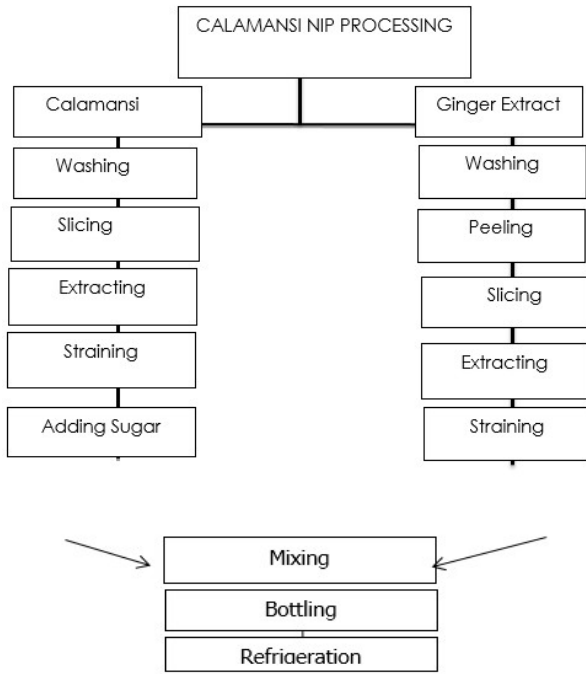
Research Design

This study employed experimental and descriptive research designs to assess the acceptability of kalamansi nip with ginger extract in terms of color, odor, flavor, and overall acceptability across different market segments. These designs were also used to describe the nutritional facts, shelf life, and cost-return analysis of kalamansi nip processing.

The experimental stage (Study 1) was conducted in a completely randomized design, with four treatments replicated three times and 10 samples per treatment. In the descriptive method, one-way ANOVA was used to determine the difference in the acceptability of kalamansi nip and juice among different segments.

Fresh kalamansi, ginger, and sugar were used in the processing of kalamansi nip and juice. Mature calamansi fruits were utilized, washed, drained, cut across the upper portion to avoid cutting the seeds, and squeezed by hand to extract the juice (Morte, 2017). Raw ginger was washed, drained, peeled, and sliced into small pieces to extract the juice using a juice extractor. Then, the strained kalamansi juice was mixed with ginger extract at the prescribed ratio for each treatment. In the second study, the ratio most acceptable to the respondents was adopted; hence, a 5% ginger extract ratio was used for further study. The kalamansi nip with ginger extract was chilled for three days undisturbed before bottling and storing.

Figure 1. Flow chart on the processing of calamansi nip with ginger extract.



A purposive sampling technique was employed to select respondents who evaluated the product’s acceptability based on its flavor, color, odor, and overall acceptability. The respondents represented various market segments, including students from elementary, high school, and college levels, as well as professionals. 80 respondents comprised this study, as presented below:

Table 1. Sample Size and Distribution

| Market Segment | Samples |
|----------------------|---------|
| Elementary Pupils | 20 |
| High School Students | 20 |
| College Students | 20 |
| Professionals | 20 |
| TOTAL | 80 |

The complete nutrient analysis, shelf-life, and acceptability in terms of color, odor, and stickiness were gathered. A liter of Kalamansi nip was subjected to a complete nutrient analysis by subjecting it to a laboratory analysis at the University of Immaculate Concepcion (UIC), Davao City. Moreover, shelf-life is the length of time a commodity can be stored without becoming unfit for

use, consumption, or sale. It was determined through daily visual evaluation. Furthermore, sensory evaluation was done to determine the acceptability of kalamansi nip with ginger extract in terms of color, odor, flavor, and general acceptability by different market segments, such as students from elementary, high school, and college, as well as professionals. A 9-point Hedonic scale was used in evaluating the acceptability of the product, as follows: 9- Like extremely, 8- Like very much, 7- Like moderately, 6- Like slightly, 5- Neither like nor dislike, 4- Dislike slightly, 3- Dislike moderately, 2- Dislike very much, and 1-Dislike extremely.

Statistical Analysis

To analyze the data gathered, the researchers computed the mean. Moreover, Analysis of Variance (ANOVA) in a complete randomized design was used to determine the significant difference in the acceptability of calamansi nip and juice in terms of color, odor, stickiness, and general acceptability, as influenced by the different levels of ginger extract and among different market segments.

RESULTS AND DISCUSSION

Acceptability of Kalamansi Nip with different concentrations of ginger extract

The results of the study showed that the ginger flavor in kalamansi juice was more pronounced in treatments with higher levels of ginger extract (Treatments 4 and 3), which were significantly different from the control. However, Treatments 2 and 1 had moderately pronounced ginger flavors that were not significantly different from each other. In terms of the acceptability of flavor, treatments with a lesser concentration of ginger extract were preferred over those with higher concentrations. However, no significant differences were noted in the flavor's acceptability.

Table 2. Acceptability of Kalamansi juice with different concentrations of ginger extract

| Particulars | Mean Acceptability Scores | | | |
|-------------|---------------------------|------------------------|---------------------------|------------------------|
| | Color | Odor | Flavor | Gen. Acceptability |
| T1-Control | 6.61-LM | 6.62- LM | 6.99- LM | 7.42- LM |
| T2- 5% | 6.47- LS ^{ns} | 6.28- LS ^{ns} | 6.72- LM ^{ns} | 7.11- LM ^{ns} |
| T3- 10% | 6.47-LS ^{ns} | 6.10- LS ^{ns} | 6.30- LS ^{ns} | 6.97- LM ^{ns} |
| T4- 15% | 6.58-LM ^{ns} | 6.26- LS ^{ns} | 5.13- NLN ^{ns} D | 6.96- LM ^{ns} |

In terms of odor, treatments 4 and 3 were both described as having a moderately strong odor that was significantly different from the control. In

contrast, treatment 2 had a mild odor that was not significantly different from treatment 1, which had a slightly weak odor. However, no significant difference was noted in the odor of Kalamansi nip regardless of the level of ginger extracts.

In terms of color, treatments 4, 3, and 2, with ginger extract, produced slightly dark-colored kalamansi juice that was significantly different from the control, which had a slightly pale color. However, no significant difference was noted in the acceptability of the color as influenced by the different levels of ginger extract. The general acceptability of kalamansi nip with different levels of ginger extract was found to be moderately liked, with no significant difference.

Acceptability of Kalamansi nip with ginger extract among different market segments

Table 3 presents the acceptability of kalamansi nip with ginger extract in terms of color, odor, thickness, and overall acceptability across different market segments.

Table 3. Acceptability of calamansi nip with ginger extract among different market segments.

| Particulars | Mean Acceptability Scores | | | |
|--------------|---------------------------|---------|------------|------------------------|
| | Color | Odor | Stickiness | Gen. Acceptability |
| Elementary | 7.70 ^{an} LVM | 6.90 LM | 6.70LM | 8.35 ^a LVM |
| High School | 7.45 ^{ab} LM | 6.65 LM | 7.15 LM | 7.70 ^{ab} LVM |
| College | 6.60 ^c LM | 7.00 LM | 7.25 LM | 7.40 ^{bc} LM |
| Professional | 6.55 ^c LM | 7.50 LM | 7.65 LM | 6.90 ^c LM |

In terms of color, the highest acceptability rating was observed among elementary pupils, who particularly enjoyed the kalamansi nip with ginger, followed by professionals, college students, and then high school students, who showed moderate liking for the product. Moreover, a significant difference in the acceptability of Kalamansi nip with ginger extract was noted in terms of color among different market segments. Using the Tukey analysis, the researchers found that the acceptability of kalamansi with ginger extract among elementary pupils was significantly higher than that of high school and college students but not significantly higher than that of professionals. Furthermore, the professionals' liking for the product differed significantly from that of high school and college students; however, no significant differences were observed between high school and college students.

In terms of odor, the Kalamansi nip with ginger extract was moderately liked by all market segments, including professionals, college students,

elementary pupils, and high school students. The results showed no significant difference in the acceptability of Kalamansi nip with ginger extract among different market segments in terms of odor. This implies that the acceptability of Kalamansi nip with ginger extract in terms of odor did not vary among different market segments.

Furthermore, in terms of stickiness, Kalamansi nip with ginger extract was highly appreciated by professionals, while college students, high school students, and elementary pupils liked it moderately. However, the results showed no significant difference, which implies that the acceptability of Kalamansi nip with ginger extract in terms of stickiness among different market segments did not vary.

Moreover, in terms of general acceptability, the highest acceptability was noted among the elementary pupils, followed by the professionals who “liked very much” the product. However, other market segments, such as college students and high school students, liked the product moderately. Moreover, Analysis of Variance showed a significant difference in the general acceptability of Kalamansi nip with ginger extract among different market segments. Using the Tukey analysis, the researcher found that the general acceptability of elementary pupils was significantly higher and different from that of the high school and college students but not significantly different from the professional. Moreover, the professionals’ acceptability of the Kalamansi nip was significantly higher than the high schools but not significantly different from the college and elementary pupils.

Acceptability of Kalamansi Juice with Ginger Extract among Different Market Segments. Table 4 presents the acceptability of kalamansi juice with ginger extract in terms of color, odor, taste, flavor, and general acceptability among different market segments.

Table 4. *Acceptability of calamansi juice with ginger extract among different market segments.*

| Particulars | Mean Acceptability Scores | | | |
|--------------|---------------------------|----------------------|------------|--------------------|
| | Color | Odor | Stickiness | Gen. Acceptability |
| Elementary | 7.50LVM | 7.05 ^a LM | 7.90 LM | 8.30 LVM |
| High School | 6.85 LM | 6.55 ^b LM | 7.90 LM | 8.00 LVM |
| College | 6.95LM | 7.30 ^a LM | 7.20 LM | 7.70 LM |
| Professional | 7.50LVM | 7.80 ^a LM | 7.75 LVM | 7.50 LM |

In terms of odor, the highest acceptability rating was noted among elementary pupils and professionals, who greatly enjoyed the Kalamansi juice with ginger, followed by college students, then high school students, who found the product moderately acceptable. Moreover, there was no significant

difference in the acceptability of calamansi juice with ginger extract in terms of color among different market segments.

In terms of odor, Kalamansi juice with ginger extract was moderately liked by all market segments, including professionals, college students, elementary pupils, and high school students. Analysis of Variance showed a significant difference in the acceptability of Kalamansi juice with ginger extract among different market segments in terms of odor. Post-hoc comparisons using Tukey's test showed that professionals had a higher acceptability rating for the product compared to the high school group.

In terms of taste, Kalamansi juice with ginger extract was liked very much by the elementary and high school students, while the professionals and college students liked it moderately. However, the results showed no significant difference in taste acceptability.

Moreover, in terms of general acceptability, the highest acceptability was noted among the elementary pupils, followed by the professionals who "liked very much" the product. Other market segments, such as college students and high school students, liked the product moderately. However, an Analysis of Variance showed no significant difference in the general acceptability of Kalamansi juice among different market segments.

Nutrient Analysis for Kalamansi Nip with Ginger Extract

Table 5 presents the available nutrients in Kalamansi nips with ginger extract, as determined using the Official Methods of Analysis of AOAC International, 19th Edition.

Table 5. *Nutrients available in the Kalamansi nip with ginger extract*

| Particulars | Kcal/100g | µg/g | % |
|---------------|-----------|--------|-------|
| Calories | 327 | | |
| Carbohydrates | | | 71.35 |
| Crude fat | | | 4.55 |
| Saturated fat | | | 4.12 |
| Crude protein | | | 0.19 |
| Total sugars | | | 59.87 |
| Sodium | | 43.68 | |
| Potassium | | 508.00 | |
| Calcium | | 101.00 | |
| Iron | | 3.73 | |
| Magnesium | | 46.35 | |
| Phosphorous | | 5.64 | |

It was shown that the Kalamansi nip with ginger extract had 327 kcal per 100g. In a similar study, Pangerapan (2016) found that one Calamansi fruit has a 12-calorie composition, consisting of a small quantity of fat, 1.2 grams of fiber, 37 milligrams of potassium, 7.3 milligrams of vitamin C, 54.4 milligrams of vitamin A, 8.4 milligrams of calcium, and water at 15.5%. Coleman et al. (2015) also stated that the calamansi nip contains 71.35% carbohydrates. Carbohydrates are the body's main source of energy and should make up the largest percentage of the daily calorie intake.

In this study, Kalamansi was found to have traces of crude fat (4.55%), saturated fat (4.12%), and crude protein (0.19%) were also determined in the laboratory analysis. Thiex et al. (2003) said that crude fat content is determined by extracting the fat from the sample using a solvent and then determining the weight of the fat recovered. As lipids/fats are relatively non-polar molecules, they can be pulled out of a sample using relatively non-polar solvents. With a non-polar solvent, only non-polar molecules in the sample dissolve, while polar ones do not. Problems arise, however, in cases where lipids are bound in animal or plant cell membranes. Animal and plant cell membranes are made up of molecules that have both polar and non-polar regions, such as triglycerides (molecules with polar glyceride heads and non-polar fatty acid tails) and phospholipids (similar to triglycerides, but a phosphate group replaces the fatty acid tail). These molecules end up grouping with their polar heads sticking outwards and non-polar tails inwards, making it difficult for non-polar solvents to interact with the nonpolar tails and extract them.

Also, Kalamansi nip with ginger was found to have crude protein, sugar, sodium, potassium, calcium, iron, magnesium, and phosphorous. According to Nadolsky (2014), crude protein is a structural molecule assembled out of amino acids, many of which the body cannot produce on its own. Moreover, Kalamansi nip with ginger extract also contains 43.68 $\mu\text{g/g}$ sodium. Martinac et al. (2007) averred that sodium is one of several minerals that are electrolytes whose primary function is to regulate fluid in the cells. The presence of potassium (508 $\mu\text{g/g}$) was also noted in the Kalamansi nip. According to Kern (2009), potassium plays a crucial role in bone strength, kidney stone production, and the risk of stroke, and as an electrolyte. It is part of the electrochemical balance that keeps the nervous system working properly. Likewise, calcium is also available in the Kalamansi nip (101.00 $\mu\text{g/g}$). Karohl et al. (2010) opined that calcium is required for vascular contraction and vasodilation, muscle function, nerve transmission, intracellular signaling, and hormonal secretion. However, less than 1% of total body calcium is needed to support these critical metabolic functions. Further, Glasdam et al. (2016) said that, like sodium, potassium, and magnesium, calcium is physiologically important due to its integral roles in metabolic and biological processes.

There was 3.73 $\mu\text{g/g}$ of iron available in the Kalamansi nip. Ware (2008) stated that iron is a vital mineral for the proper function of hemoglobin, a

protein necessary for transporting oxygen in the blood. Iron also plays a crucial role in various other important bodily processes. Zhang et al. (2019) said that iron disorders are linked to heart failure. Iron is essential for mitochondrial function and various enzyme activities, and iron deficiency has a particularly negative impact on mitochondrial function.

Moreover, 46.35 µg/g of magnesium was found in the Kalamansi nip. According to Erdman et al. (2012), magnesium, an abundant mineral in the body, is naturally present in many foods, added to other food products, available as a dietary supplement, and present in some medicines (such as antacids and laxatives). Likewise, 5.64 µg/g of phosphorus was also found in the Kalamansi nip. Wellman (2004) noted that phosphorus is the second most plentiful mineral in the body after calcium. The body requires phosphorus for various functions, including filtering waste and repairing tissue and cells.

Shelf-Life

The Kalamansi nips and juice were placed in a bottled container and then sealed on January 24, 2018, at room temperature.

Table 6. *Shelf-life of Calamansi Nip and Juice*

| Product | Start of Observation | End of Monitoring | ShelfLife |
|-----------------|----------------------|-------------------|-----------|
| Calamansi Nip | January 24, 2018 | January 27, 2018 | 3 days |
| Calamansi Juice | January 24, 2018 | March 20, 2018 | 54 days |

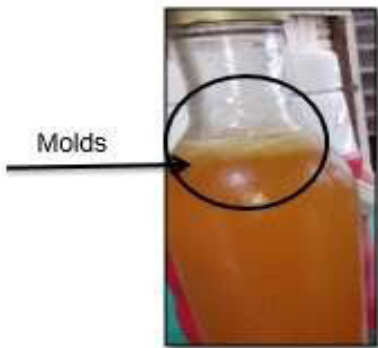


Plate No. 1. *Image of the Kalamansi nip at 54 days showing the appearance of molds.*

Monitoring was conducted every morning until signs of mold were observed. Observation for Calamansi nip and juice began on January 24, 2018. After three days, signs of mold appeared on Calamansi nip, while Calamansi

juice developed signs of mold on March 20, 2018, as shown in Plate No. 1. The shelf life of Calamansi nip reached 3 days, whereas the juice lasted for 54 days.

Profitability of Kalamansi Nip with Ginger Extract

The return on Investment (ROI) was computed, and a summary of the results is shown in Table 7 below.

Table 7. *Return on Investment of calamansi nip with different levels of ginger extract*

| Particulars | T1 | T2 | T3 | T4 |
|--|--------|--------|--------|--------|
| Total Yield | 500ml | 510ml | 520ml | 530ml |
| No. of 300 ml bottles of calamansi nip | 1.66 | 1.7 | 1.73 | 1.76 |
| Suggested Retail price/bottle | 60 | 80 | 85 | 90 |
| Net Sales | 99.6 | 136.00 | 147.05 | 158.4 |
| Expenses | | | | |
| Materials/Ingredients | 49.5 | 53.21 | 56.99 | 60.7 |
| Labor | 37.5 | 56.25 | 56.25 | 56.25 |
| Total Expenses | 87 | 109.46 | 113.24 | 116.95 |
| Net Income | 12.6 | 26.54 | 34.05 | 41.45 |
| ROI (%) | 14.48% | 24.25% | 30.07% | 35.44% |

The costs were computed comprising of the raw materials or ingredients and the labor costs that were computed based on the number of hours spent in the production. Net sales were computed based on the quantity produced. The higher level of ginger extract produced a higher yield expressed in a number of bottles with 300 ml net content. The yields were multiplied by the selling price per bottle and increased with the level of ginger extract as a result of value-adding. The costs were deducted from the net sales to arrive at the profit. The cost ratio over the profit was computed, thus getting the Return on Investment.

Results showed that treatment 4 (15% ginger extract) got the highest.

The ROI of 35.44% was achieved with treatment 3 (10% ginger extract), followed by treatment 2 (5% ginger extract) with an ROI of 24.25%. Treatment 1 (control) yielded the lowest ROI of 14.48%. However, regardless of the treatments used, it can be noted that the production of Kalamansi nip with different levels of ginger extract showed a good ROI and could be a profitable undertaking to consider.

SUMMARY AND CONCLUSION

This study was conducted to develop a healthier substitute for soda and other synthetic beverages. First, it aimed to determine the acceptability of Kalamansi nip enhanced with ginger extract at different concentrations. Second, it sought to assess the acceptability of Kalamansi nip with ginger extract among different market segments. Third, it subjected samples of the product to a comprehensive nutritional analysis to determine the nutrients available in the Kalamansi nip with ginger extract. Lastly, it aimed to determine the shelf life of the developed product and assess its profitability.

Kalamansi juice with higher concentrations of ginger extract exhibited a more pronounced ginger flavor, a stronger odor, and a darker color compared to the control, with a significant difference. However, acceptability in terms of the above parameters showed no significant difference. General acceptability was also found to be the same in all treatments, which were liked moderately without significant differences.

There was a significant difference in the acceptability of Kalamansi nip with ginger extract in terms of color among different market segments. Elementary pupils particularly liked the Kalamansi nip with ginger, whereas other market segments, including professionals, college students, and high school students, showed a moderate preference for the product. In terms of odor, Kalamansi nip with ginger extract was moderately liked by all market segments without significant differences.

There was no significant difference in the acceptability of Kalamansi juice with ginger extract in terms of color, taste, and general acceptability among different market segments. However, in terms of odor, professionals had a moderate liking for the product, which was significantly higher compared to that of high school students.

It was shown that the Kalamansi nip with ginger extract contains 327 kcal per 100g. The composition of this product includes 71.35% carbohydrates, 4.55% crude fat, 4.12% saturated fats, and 0.19% crude protein. Additionally, the Kalamansi nip with ginger extract has the following nutritional values: sodium - 43.68 µg/g, potassium - 508 µg/g, calcium - 101 µg/g, and phosphorus - 508 µg/g.

At room temperature, the shelf life of calamansi nip lasted for 54 days, whereas the juice reached only 3 days.

IMPLICATION AND RECOMMENDATIONS

Based on the findings and conclusions of the study, the following recommendations are hereby offered:

1. The Kalamansi nip is proven to contain nutrients required for health. Hence, mass production and commercialization may be considered. A nutrient analysis of the end product, which is the Kalamansi juice,

may also be conducted.

2. The shelf-life of Kalamansi nip is limited to 3 days only; hence, further development may be initiated to extend its shelf-life.
3. The development of packaging materials may also be done on the products.

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